

REMARKS

In the Office Action, the Examiner rejected Claims 11-19, which were all of the then pending claims, over the prior art, principally U.S. Patent 6,525,403 (Inaba, et al.). In particular, Claims 11-16 were rejected under 35 U.S.C. 102 as being fully anticipated by Inaba, et al; and Claims 17-19 were rejected under 35 U.S.C. 103 as being obvious over Inaba, et al. in view of U.S. Patents 4,743,565 (Goth, et al.) and 6,413,802 (Hu, et al.).

Claim 11 is being amended to better define the subject matter of the claim. Original Claim 17 is being cancelled, and new independent Claim 20 is being added as a substitute for that Claim 17. Claims 18 and 19 are being amended to be dependent from new Claim 20 instead of the now cancelled Claim 17. New Claims 21 and 22, which are dependent from Claim 11, are being added to describe preferred features of the invention.

For the reasons discussed below, Claims 11-16 and 18-22 patentably distinguish over the prior art and are allowable. The Examiner is thus requested to reconsider and to withdraw the rejection of Claims 11-16 under 35 U.S.C. 102, and the rejection of Claims 18 and 19 under 35 U.S.C. 103, and to allow Claims 11-16 and 18-22.

Claims 11-16 and 18-22 patentably distinguish over the prior art because the prior art does not disclose or suggest the type of dopant diffusion described in independent Claims 11 and 20. Specifically, the prior art does not disclose the dopant diffusion to a predetermined depth in the semiconductor body that is dependent on the thickness of the semiconductor body and the concentration of the dopant ions. In order to best understand this difference, and the importance of this difference, between the present invention and the prior art, it may be helpful to review briefly this invention and that prior art.

The present invention, generally, relates to a semiconductor structure having a resistor or a diode formed in the structure. More specifically, this invention relates to a resistor or diode formed within a thin vertically oriented semiconductor structure, referred to as a fin. In accordance with this invention, that fin is formed, and an off-axis implant procedure is used to dope regions of the fin extending inward from the vertical surfaces of the fin.

At this point, the doped regions do not extend completely across the width of the fin, however, and a subsequent step, preferably an annealing procedure, is employed to disperse the dopant through the fin. A pair of contacts is formed in the structure, and depending on how those contacts are formed, the resulting structure may be either a resistor or a diode.

An important feature of the present invention is that, when the dopants are dispersed or diffused through the fin, the dopant ions are diffused through the fin to a predetermined depth that is dependent on the thickness of the fin as well as the concentration of the dopant ions. As a result of this feature, the resistance of the fin structure is independent of the thickness of the fin. Also, when the present invention is used as a gate, this feature of the invention eliminates the nominal process variations on fin thickness from the variation on threshold voltage.

The prior art does not disclose or suggest determining the diffusion depth as a function of both the thickness of the fin and the concentration of the dopant ions.

In particular, Inaba, et al. describes several embodiments of a semiconductor device having a doped projection. The procedure of Inaba, et al. is directed toward forming gate structures having lengths of 0.1 μm or less. While Inaba, et al discloses

several specific doping regions, this reference does not teach diffusing the dopant through the semiconductor body as a function of both the thickness of the fin and the concentration of the dopant ions.

The other references of record have been reviewed, and these other references, whether they are considered individually or in combination, also fail to disclose or suggest this principal of the present invention.

For example, Goth, et al. was cited for its disclosure of a diode having contacts that are of opposite dopant style. Hu, et al. discloses a Finfet device including a diode, where one contact has a conductivity type dopant that is different from the dopant type of an adjacent dopant region, and where the other contact of the diode is silicide. Neither of these references discloses or suggests the type of dopant diffusion used in the present invention.

Independent Claims 11 and 20 describe the above-discussed feature of this invention. In particular, both of these claims describe a doped region extending inward from a vertical surface of at least one vertically oriented semiconductor body. Both Claims 11 and 20 describe the further feature that the dopant ions of this doped region are diffused into the semiconductor body to a predetermined depth that is dependent on the thickness of the semiconductor body and the concentration of the dopant ions.

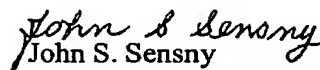
In addition, with specific regard to Claim 11, which is directed to the embodiment of the invention in which the fin structure forms a resistor, Applicants wish to note that all prior art cited by the Examiner contains a dopant junction creating either a diode or a transistor. The present application teaches the fabrication of a device with no dopant junction (explicitly) to form a resistor. The removal of the dopant junction to change the

device from a diode or transistor to a resistor would "increase the speed performance of the device". However, this change drastically alters the electrical behavior of the device.

Because of the above-discussed differences between Claims 11 and 20 and the prior art, and because of the advantages associated with those differences, Claims 11 and 20 patentably distinguish over the prior art and are allowable. Claims 12-16, 21 and 22 are dependent from Claim 11 and are allowable therewith, and Claims 18 and 19 are dependent from, and are allowable with, Claim 20. The Examiner is, accordingly, respectfully requested to reconsider and to withdraw the rejection of Claims 11-16 under 35 U.S.C. 102, and the rejection of Claims 18 and 19 under 35 U.S.C. 103, and to allow Claims 11-16 and 18-22.

Every effort has been made to place this application in condition for allowance, a notice of which is requested. If the Examiner believes that a telephone conference with Applicants' Attorneys would be advantageous to the disposition of this case, the Examiner is asked to telephone the undersigned.

Respectfully submitted,


John S. Sensny
Registration No. 28,757
Attorney for Applicants

SCULLY, SCOTT, MURPHY & PRESSER
400 Garden City Plaza - Suite 300
Garden City, New York 11530
(516) 742-4343

JSS:jy